VSD Pump Control

California Building Energy Efficiency Standards
Revisions for July 2003 Adoption

November 5, 2001

Description

Electronic variable-speed drives (VSDs) for variable-flow hot-water and chilled-water pumping systems are now highly reliable and relatively inexpensive. However, the existing Standards do not require any capacity control mechanism for the pumps.

The Standards should consider requiring VSDs, or equivalent unloading mechanisms, for all variable-flow pumping systems of approximately 7.5 hp and greater.

Benefits

Variable-flow pumping systems are quite common, but pump unloading mechanisms are not as common. Instead, most systems allow the pump to ride the curve, thereby consuming more energy than would otherwise be used.

Time dependent valuation would reduce the benefits of this measure, as the energy savings will accrue principally in the non-peak hours. However, since engineers normally apply a safety factor to their load calculations, savings during on-peak periods are also expected. In fact, this technology allows reasonably oversized pumping system to operate more efficiently than if they were sized to exactly meet the load.

Environmental Impact

VSDs can create harmonic distortion on power lines, which can affect sensitive electronic equipment and can reduce the power factor of a building. These effects are commonly mitigated using filters.

There are no other significant environmental impacts in buildings.

The manufacture of VSDs shares the same environmental considerations as the electronic industry in general.

Type of Change

Prescriptive Requirement	The change would add or modify a prescriptive requirement. Prescriptive requirements must be met for prescriptive compliance and define the Standards baseline building in performance calculations, but are not mandatory when the performance approach is used.

The proposed change expands the existing scope of the standards. Currently, the Standards do not regulate pumping systems at all.

This change would affect all documents: Standards, ACM, manuals, and compliance forms.

Measure Availability and Cost

Electronic VSDs have been available for over 15 years, are now considered highly reliable, and the manufacturers are well-known to HVAC designers and mechanical contractors.

Given the lead time between adoption and enforcement, manufacturers should be quite capable of meeting the demand. As pumping systems are always built up, (not part of packaged equipment), there should be no significant problem in incorporating VSDs into the systems.

For life cycle cost analysis, the baseline conditions would be current Standards.

The cost varies by size, with larger sizes costing less per horsepower than smaller sizes. The contractor cost (uninstalled) ranges from $800 for a 10 horsepower VSD to $2,800 for a 50 horsepower drive. Net installed cost, including control points and commissioning, ranges from $2,050 to $5,680 respectively. Manufacturer's warranties are typically 2 years parts and labor. Of the above costs, commissioning is about $200.

Useful Life, Persistence and Maintenance

VSDs have matured considerably over the last 10 years, and the technology is different than it was 10 years ago. The currently generation of drives is expected to last at least 10 years, but is too new to have been demonstrated for that period.

Energy savings will be consistent over the life of the drive.

Performance Verification

The installation requirements of VSDs are well understood by electrical engineers and controls contractors. The most critical aspects in commissioning the device are:

1. Verification to ensure that the unit is installed in accordance with manufacturers recommendations,
2. The differential pressure sensor is installed at a representative location in the piping, and the required setpoint is specified by the HVAC engineer.
3. Many DDC systems can achieve additional savings by dynamically resetting the differential setpoint based on the worst-case valve position.

Cost Effectiveness

Numerous *Savings by Design* DOE-2 studies for Southern California Edison, as well as others, indicate that VSD pump control has a typical payback of 2-3 years.

Analysis Tools

DOE-2.2 can simulate variable-speed pumps; previous versions do not.

Relationship to Other Measures

No other measures are impacted by this change.

Bibliography and Other Research

VSD pump control is a very common measure analyzed in the *Savings by Design* programs of California's investor-owned utilities.

Currently, this submittal is intended as a place holder to identify this topic as a subject that the Standards do not address.